

Strategy for Achieving True Sub-Micron Orbit Stabilization at the Advanced Photon Source

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APS Orbit Correction System Components

- 360 broadband RF BPMs
- 48 narrowband RF BPMs (mounted on ID vacuum chambers)
- 48 insertion device X-ray BPMs
- 38 bending magnet X-ray BPMs
- 317 combined-function horizontal / vertical corrector magnets
- 21 VME crates, each with 2 DSP boards for real-time feedback
- One additional DSP board used in feedback crates for X-ray and narrowband BPM data acquisition and filtering.
- Singular Value Decomposition (SVD) algorithm used in DC and AC systems.
- Workstation-based algorithm operates up to 0.1 Hz
- Real-time algorithm operates from 0.1 to 60 Hz
 - Access to 38 “fast” correctors
 - Access to all RF and X-BPM data (not all used in algorithm)

Systematic Effects Impacting APS Orbit Correction

RF BPM systematic effects

- Timing / trigger stability
- Intensity dependence
- Bunch pattern dependence
- The "rogue" microwave chamber modes
- Electronics thermal drift

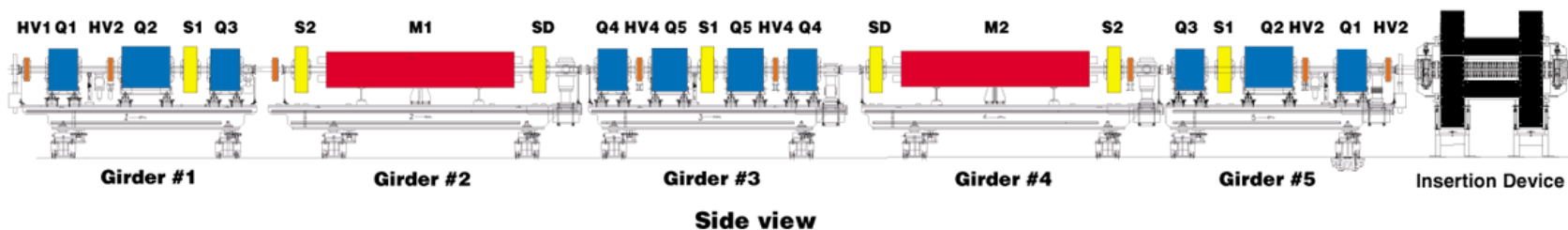
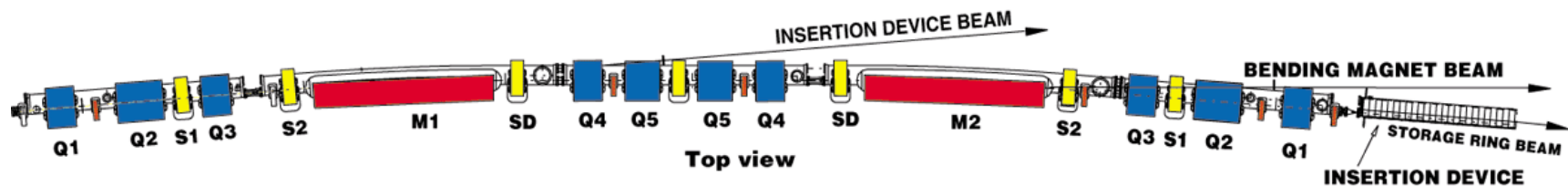
X-ray BPM systematic effects

- Stray radiation striking X-bpm blade pickups
- X-bpm blade misalignment
- Electronics thermal drift
- ID Gap-dependent effects
(e.g. sensitivity, steering)

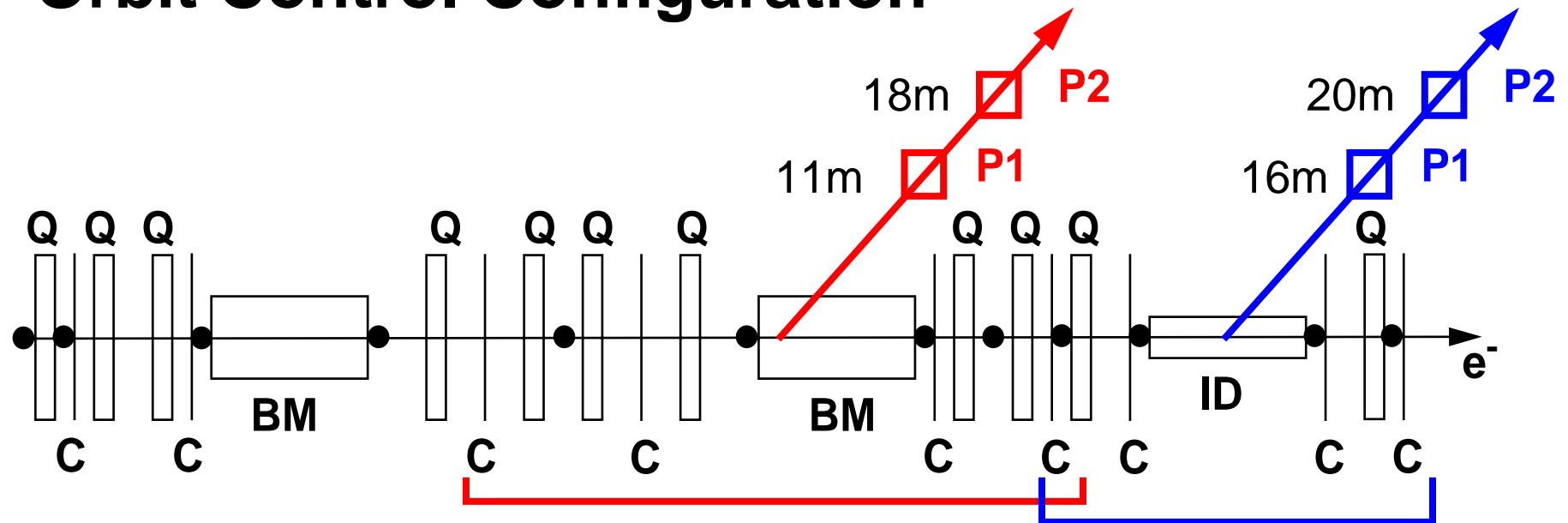
Extrinsic systematic effects (noise sources)

- Magnet power supply noise / ripple
- RF system high voltage power supply
- Mechanical vibration
- Thermal effects (Tunnel air / water temperature)
- Earth tides
- Insertion device gap changes

One Sector of the Advanced Photon Source Storage Ring



Orbit Control Configuration



Legend:

C: Corrector Magnet

●: RF Beam Position Monitor

X: X-ray Beam Position Monitor

Q: Quadrupole

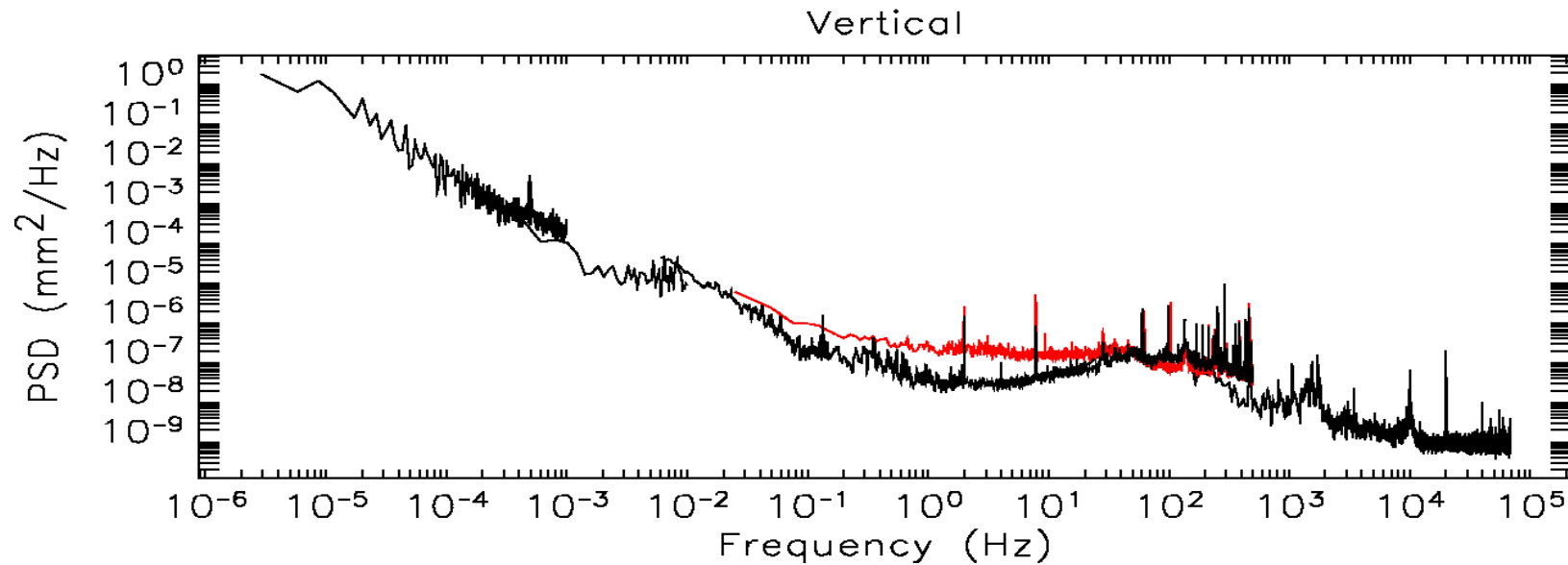
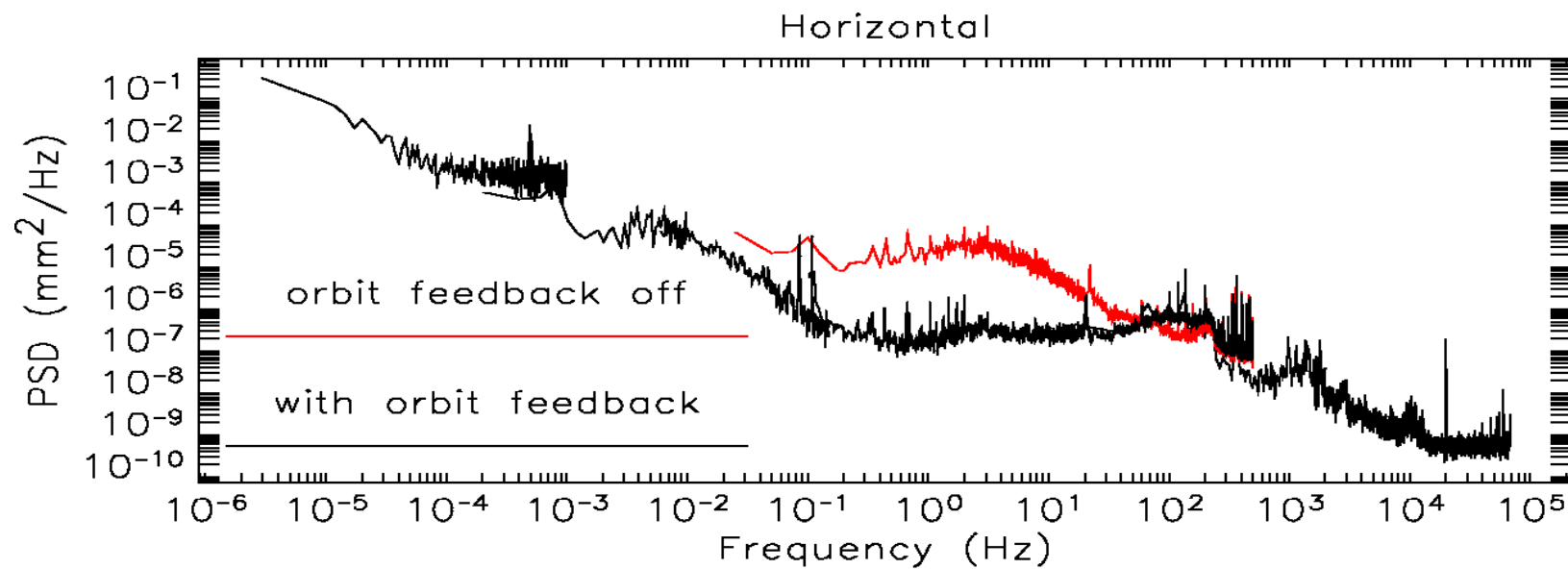
BM: Bending Magnet

ID: Insertion Device

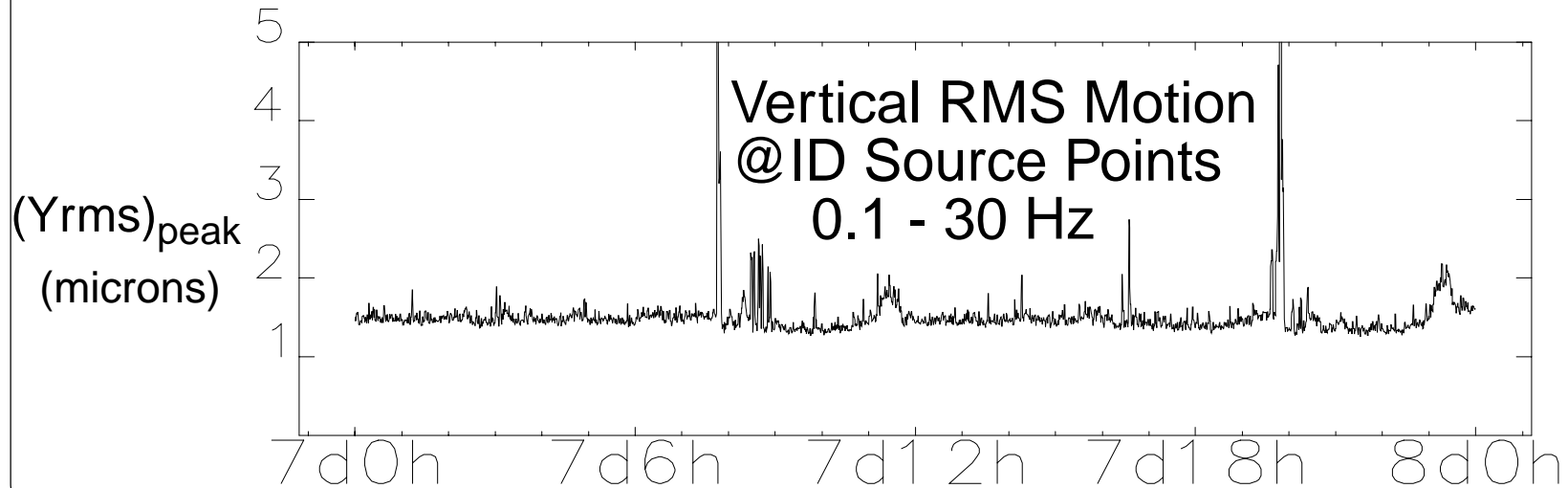
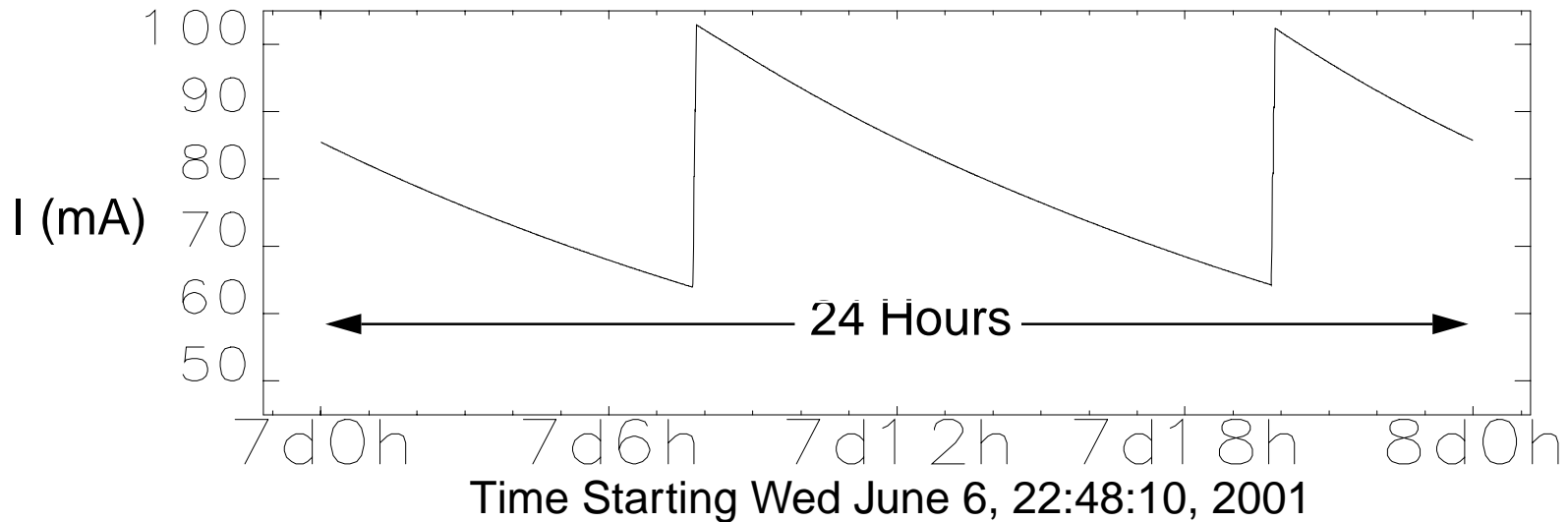
Config.	BPMs	Correctors
Global	11 RF (all)	2
Local - 1	P1 or P2	4
Local - 2	P1 and P2	4

XBPM weight = 5; RFBPM weight = 1

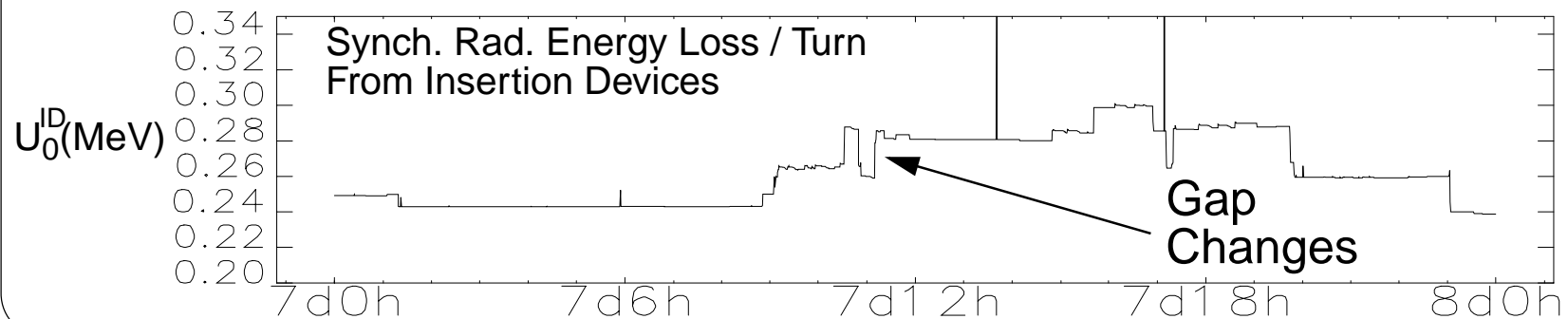
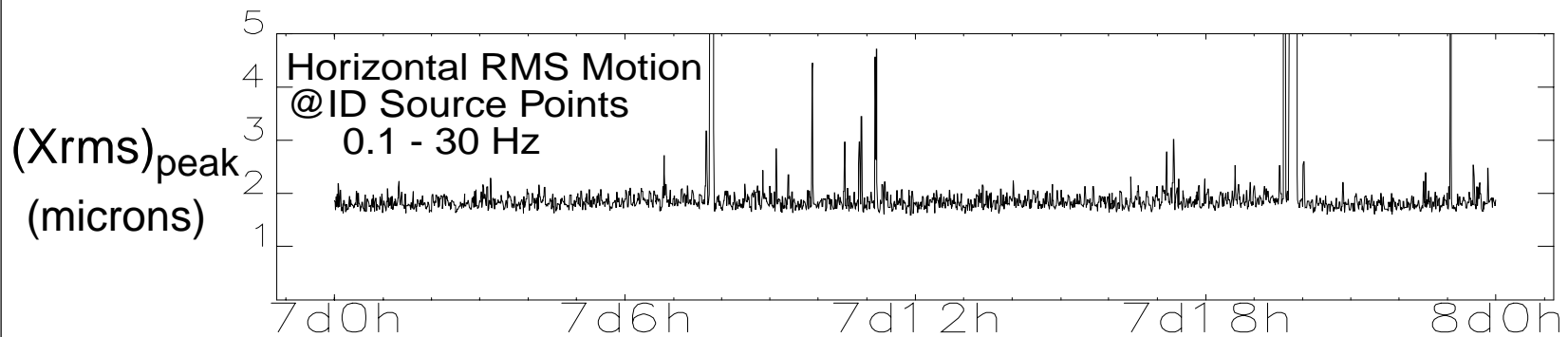
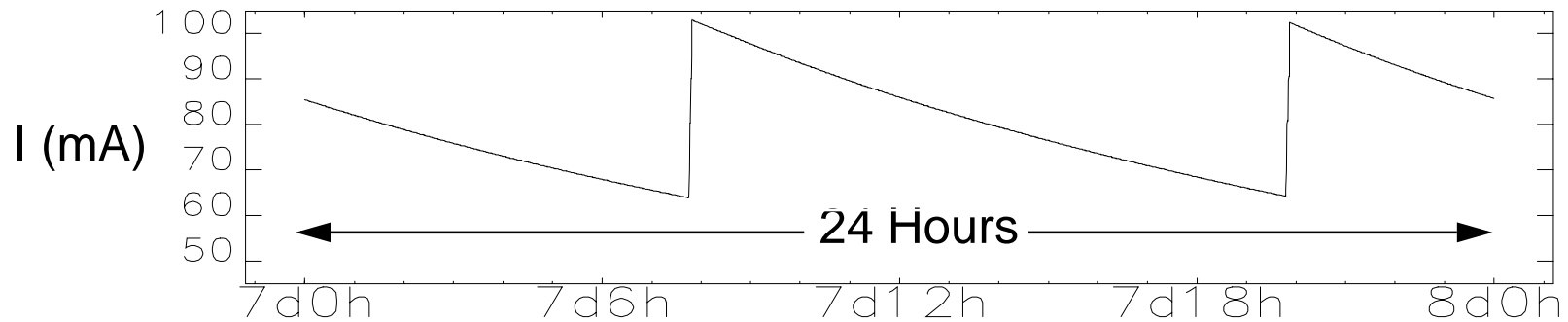
Spectrum of Beam Motion Averaged over ID Source Points



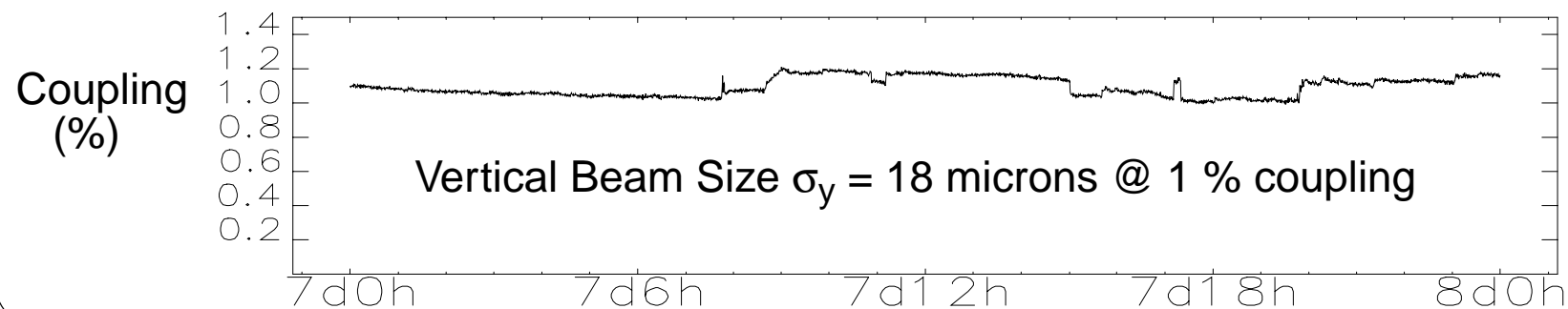
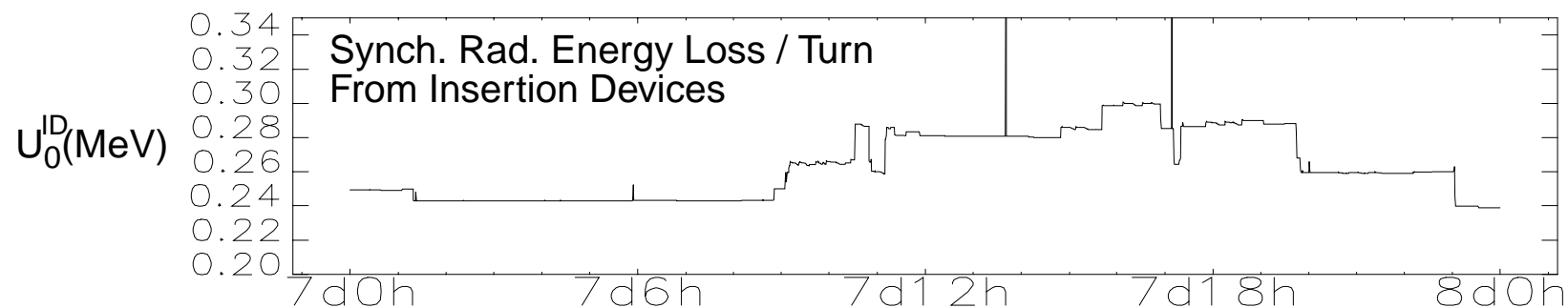
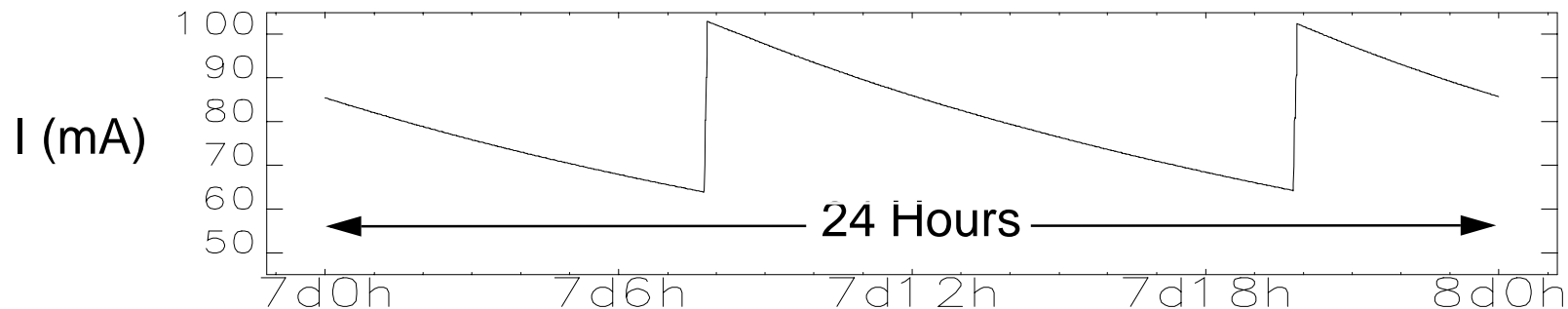
Stored Beam Current



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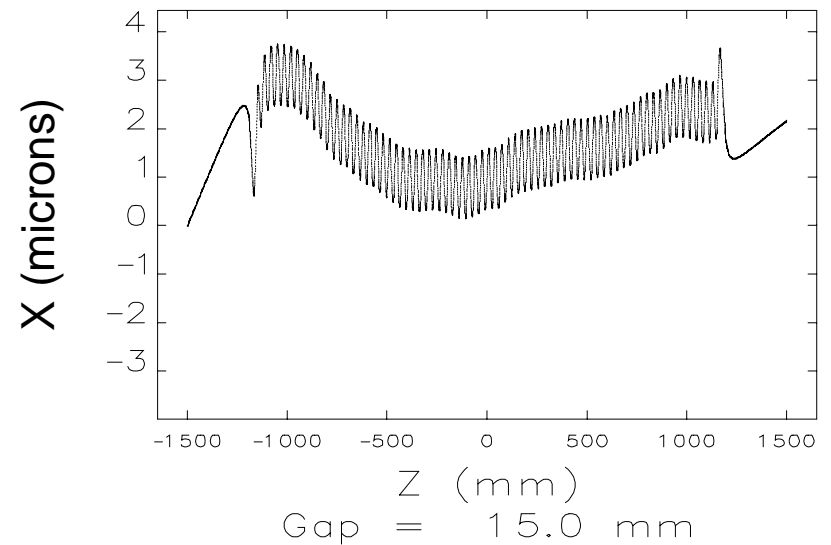
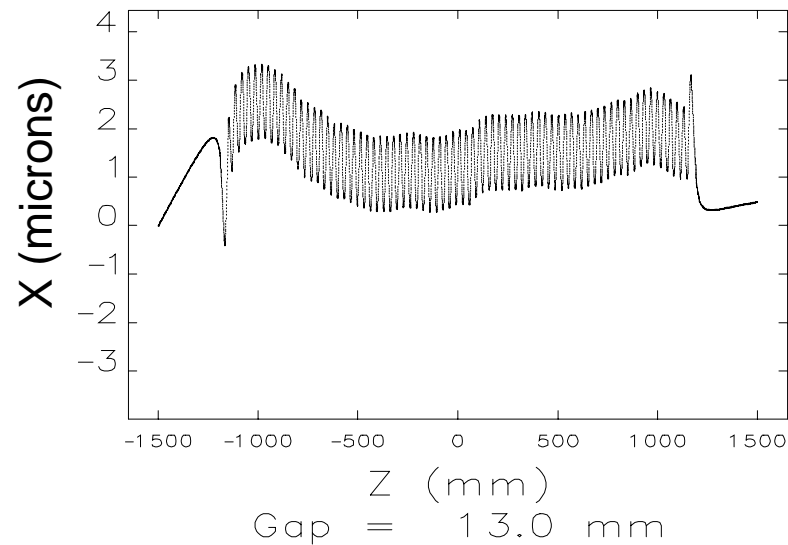
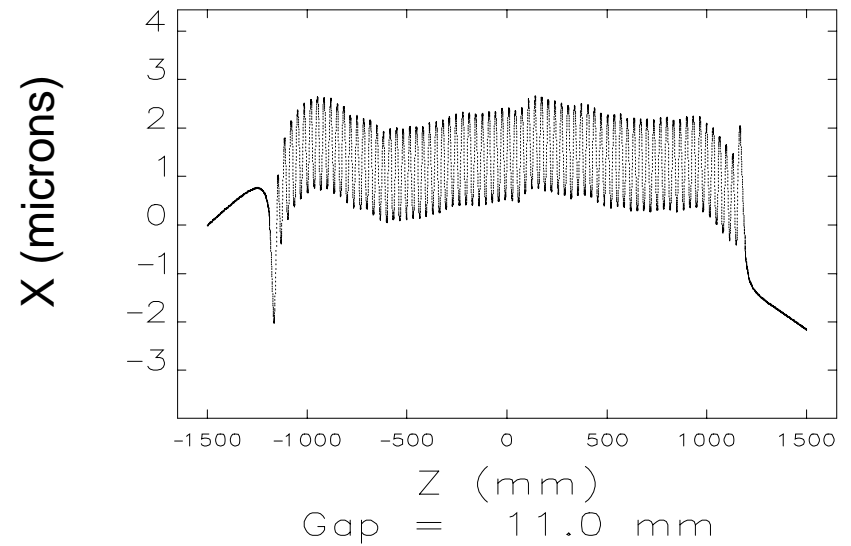
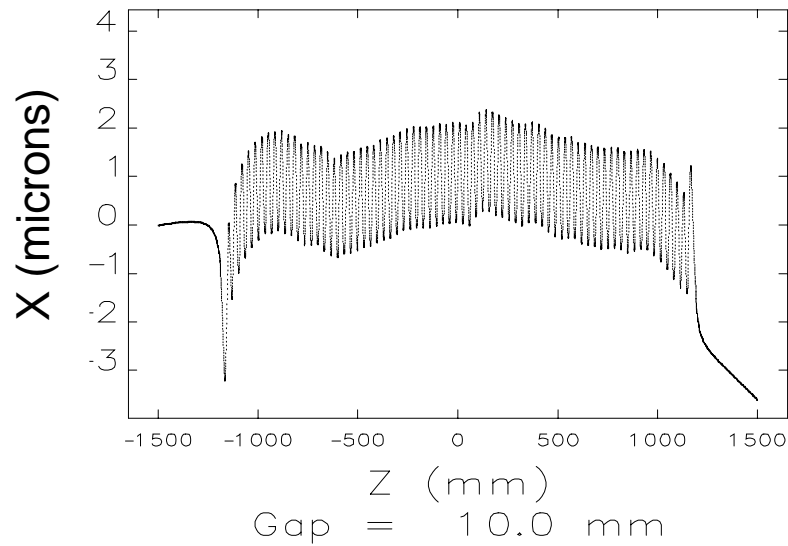


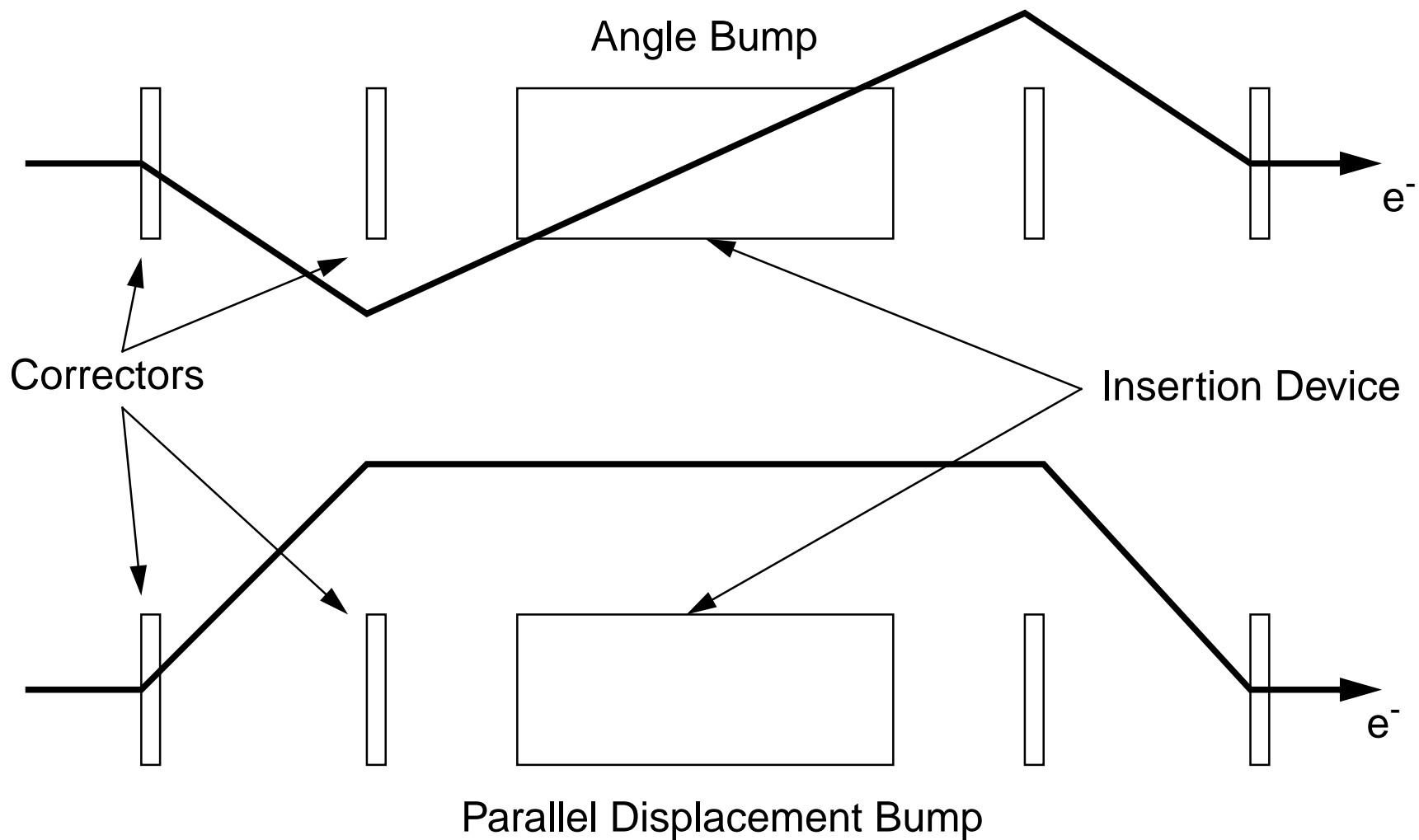
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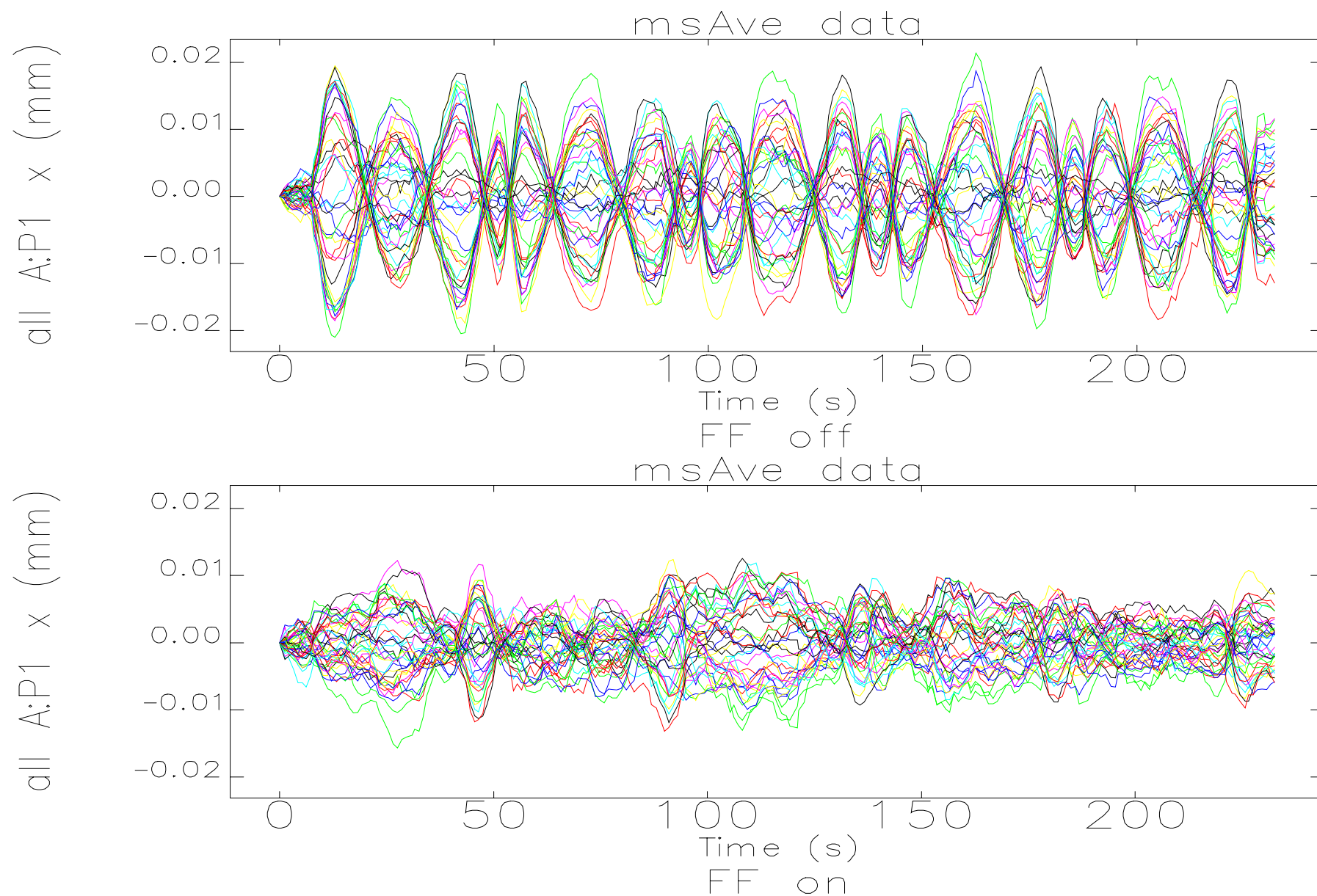
Variation of Particle Trajectory Through Insertion Device vs Gap

(Derived from Second Field Integral of Magnetic Measurement Data)





Variation of RF bpm's while cycling 33ID from 15 to 30 mm gap- FF on vs off



Argonne National Laboratory
Advanced Photon Source
AOD Diagnostics



Operational Experience with X-ray BPMs
PAC 2001, June 18-22, 2001, Chicago, IL
Om Singh and Glenn Decker

Sector 32-ID X-bpm Feedback Results

Horizontal

Gap = 27.5 mm

Vertical

